CLAIMS:

1. A receiver suitable for a base station of a CDMA communications system comprising at least one base station (11) having a transmitter and a said receiver and a multiplicity (U) of user stations ($10^1,\ldots,10^U$) including a plurality (U′) of user stations served by said at least one base station, each user station having a transmitter and a receiver for communicating with said at least one base station via a corresponding one of a plurality of channels ($14^1,\ldots,14^U$), the base station receiver for receiving a signal (X(t)) comprising components corresponding to spread signals transmitted by the transmitters of the plurality of user stations, each of said spread signals comprising a series of symbols spread using a spreading code unique to the corresponding user station, said base station receiver comprising:

a plurality (U′) of receiver modules ($20^1,\ldots,20^{NI},20^d$) each for deriving from successive frames of the received signal (X(t)) estimates of said series of symbols of a corresponding one of the user stations,

preprocessing means (18) for deriving from the received signal (X(t)) a series of observation matrices (Y_n) each for use by each of the receiver modules (20) in a said frame to derive an estimate of a symbol of a respective one of said series of symbols, and

means (19,44;44/1,44/2) for deriving from each observation matrix a plurality of observation vectors $(\underline{Y}_n;\ \underline{Y}_{n-1};\ \underline{Z}^1_n \ldots \underline{Z}^{NI}_n;\ \underline{Z}^d_n)$ and applying each of the observation vectors to a respective one of the plurality of receiver modules ($20^1,\ldots,20^{NI},20^d$); each receiver module comprising;

channel identification means (28) for deriving from one of the observation vectors a channel vector estimate $(\hat{\underline{H}}^1_n,\ldots,\hat{\underline{H}}^{NI}_n;\hat{\underline{Y}}^d_{0,n};\hat{\underline{Y}}^d_{0,n-1})$ based upon parameter estimates of the channel between the base station receiver and the corresponding user station transmitter;

beamformer means ($27^1,\ldots,27^{NI},27^d$; 47^d) having coefficient tuning means (50) for producing a set of weighting coefficients in dependence upon the channel vector estimate, and combining means (51,52) for using the weighting coefficients to weight respective ones of the elements of a respective one of the observation vectors and combining the weighted elements to provide a signal component estimate $(\hat{s}^1_n,\ldots,\hat{s}^U_n)$; and

symbol estimating means ($29^1,\ldots,29^U$, $30^1,\ldots,30^U$) for deriving from the signal component estimate an estimate ($\hat{b}_n^1,\ldots,\hat{b}_n^U$) of a symbol ($b_n^1,\ldots,b_n^U$) transmitted by a corresponding one of the user stations ($10^1,\ldots,10^U$),

wherein said receiver further comprises means (42,43) responsive to symbol estimates ($\hat{b}_n^1,\ldots,\hat{b}_n^{NI};g^1,g^2,g^3;g^{l,1,n}$) and to channel estimates ($\mathcal{H}_n^1 \ldots \mathcal{H}_n^{NI};\mathcal{H}_{n-1}^{l}$) comprising at least said channel vector estimates ($\hat{H}_n^1,\ldots,\hat{H}_n^{NI}$) for channels ($14^1,\ldots,14^{NI}$) of a first group (I) of said plurality of user stations ($10^1,\ldots,10^{NI}$) to provide at least one constraint matrix ($\hat{C}_n$) representing interference subspace of components of the received signal corresponding to said predetermined group, and in each of one or more receiver modules ($20A^d$) of a second group (D) of said plurality of receiver modules, the coefficient tuning means ($50A^d$) produces said set of weighting coefficients in dependence upon both the constraint matrix ($\hat{C}_n$) and the channel vector estimates ($\hat{H}_n^d$) so as to tune said one or more receiver modules ($20A^d$) each towards a substantially null response to that portion of the received signal (X(t)) corresponding to said interference subspace.

2. A receiver according to claim 1, wherein said coefficient tuning means ($50A^d$) also tune said one or more receiver modules ($20A^d$), respectively, each towards a substantially unity response for the component of the received signal (X(t)) from the transmitter of the corresponding one of the user stations.

3. A receiver according to claim 1, wherein the observation vector deriving means (19;44) comprises first reshaping means (44) for reshaping the observation matrix (Y_n) from the preprocessing means (18) and supplying the resulting observation vector ($\underline{Y}_n$) to said beamformer means ($47A^d$) of each of said one or more receiver modules ($20A^d$), and wherein the means (42,43) for providing said at least one constraint matrix comprises constraints-set generating means (42A) responsive to said channel estimates ($\mathcal{H}_n^1,\ldots,\mathcal{H}_n^{NI};\mathcal{H}_{n-1}^{l}$) symbol estimates ($\hat{b}_n^1,\ldots,\hat{b}_n^{NI};g^1,g^2,g^3;g^{l,1,n}$) corresponding to said first group for generating a plurality of constraints-set matrices ($C_n^1,\ldots,C_n^{N_c}$) together characterizing the subspace of interference attributable to said first group of user stations and the constraint matrix generating means (43A)

comprises a bank of vector reshapers $(48A^1, ..., 48A^{N_c})$ for reshaping the constraints-set matrices $(C^1_n, ..., C^{N_c}_n)$ to form columns, respectively, of the constraint matrix $(\hat{C}_n)$, the constraint matrix generating means (43A) supplying the constraint matrix to each of said coefficient tuning means ($50A^d$) of said one or more receiver modules (20^d) of said second group, and wherein, in each of said one or more receiver modules ($20A^d$), the channel estimation means ($28A^d$) supplies spread channel vector estimates $(\underline{Y}^d_{0,n})$ to the coefficient tuning means ($50A^d$) for use in updating said weighting coefficients.

4. A receiver according to claim 3, wherein said constraint matrix generating means (43A) comprises transformation means (49A) for forming an inverse matrix (Q_n) in dependence upon the constraint matrix $(\hat{C}_n)$ and supplying said inverse matrix to said coefficient tuning means ($50A^d$) of said one or more receiver modules ($20A^d$), and wherein said coefficient tuning means ($50A^d$) computes said weighting coefficients in dependence upon said constraint matrix, said inverse matrix and said channel vector estimate.

5. A receiver according to claim 1, wherein the observation vector deriving means comprises a plurality of despreaders ($19^1, \ldots, 19^{NI}, 19^d$) each for using a corresponding one of the user spreading codes to despread the observation matrix (Y_n) using a respective one of the spreading codes to form a user-specific post-correlation vector $(\underline{Z}^1_n, ..., \underline{Z}^{NI}_n, \underline{Z}^d_n)$ and supplying same to a respective one of the channel identification means ($28^1, \ldots, 28^{NI}, 28^d$).

6. A receiver according to claim 3, further comprising means ($30^1, \ldots, 30^{NI}$) for deriving amplitude estimates $(\hat{\psi}^1_n, ..., \hat{\psi}^{NI}_n)$ of signal components from said first group of user stations and supplying the amplitude estimates to said constraints-set generating means as parts of said channel estimates, and wherein the constraints-set generating means (42C) comprises a plurality of respreaders ($57C^1, \ldots, 57C^{NI}$) each for using a corresponding one of the user spreading codes to respread a respective one of the symbol estimates $(\hat{b}^1_n, ..., \hat{b}^{NI}_n)$ from the receiver modules corresponding to said first group (I) of user stations, scaling means ($58C^1, \ldots, 58C^{NI}$) for scaling the respread symbol estimates by the amplitudes $(\hat{\psi}^1_n, ..., \hat{\psi}^{NI}_n)$ of the signal components corresponding to the symbol estimates

$(\hat{b}_n^1, \ldots, \hat{b}_n^{NI})$, respectively, and a plurality of channel replication means (59C^1,…,59C^{NI}) having coefficients adjustable in dependence upon the channel vector estimates $(\hat{\underline{H}}_n^1, \ldots, \hat{\underline{H}}_n^{NI})$, respectively, for filtering the corresponding respread and scaled symbol estimates to provide user-specific observation matrix estimates $(\hat{Y}_{n-1}^1, \ldots, \hat{Y}_{n-1}^{NI})$, respectively, and means (60) for summing the user-specific observation matrices to form an observation matrix estimate $(\hat{I}_{n-1})$, and supplying same to the constraint matrix generator means (43C), the constraint matrix generator means (43C) comprising vector reshaping means for reshaping the observation matrix estimate $(\hat{I}_{n-1})$ to form an observation vector estimate $(\hat{\underline{I}}_{n-1})$ as a single column constraint matrix $(\hat{C}_n)$ for application to the coefficient tuning means (50A^d) of each of said receiver modules (20^d) of said second group (D).

7. A receiver according to claim 3, wherein the constraints-set generating means (42D) generates a number of constraints (N_c) equal to the number (NI) of user stations in said first group (I) and comprises a plurality of respreaders (57D^1,…3,57D^{NI}) each for using a corresponding one of the user spreading codes to respread a respective one of the symbol estimates $(\hat{b}_n^1, \ldots, \hat{b}_n^{NI})$ from a predetermined group (I) of said receiver modules corresponding to said selected ones of said components of the received signals, and a plurality of channel replication means (59D^1,…,59D^{NI}) having coefficients adjustable in dependence upon the channel vector estimates $(\hat{\underline{H}}_n^1, \ldots, \hat{\underline{H}}_n^{NI})$, respectively, for filtering the corresponding respread symbol estimates to provide a plurality of user-specific observation matrix estimates $(\hat{Y}_{n-1}^1, \ldots, \hat{Y}_{n-1}^{NI})$ respectively, and wherein, in the constraint matrix generator (43D), the bank of vector reshapers $(48A^1, \ldots, 48A^{N_c})$ reshape the user-specific observation matrix estimates to form a plurality of user-specific observation vector estimates $(\hat{\underline{Y}}_{n-1}^1, \ldots, \hat{\underline{Y}}_{n-1}^{NI})$, respectively, as respective columns of the constraint matrix $(\hat{C}_n)$ for supply to each of the coefficient tuning means (50A^d) of each of said receiver modules (20^d) of said second group (D).

8. A receiver according to claim 3, wherein the plurality of channel identification means (28^1,…,28^{NI}) of said first group of receiver modules (20E^1,…,20E^{NI}) provide both the channel vector estimates $(\hat{\underline{H}}_n^1, \ldots, \hat{\underline{H}}_n^{NI})$, respectively, and a plurality of sets of sub-channel vector estimates $(\hat{H}_n^{1,1}, \ldots, \hat{H}_n^{1,N_f}, \ldots, \hat{H}_n^{NI,1}, \ldots, \hat{H}_n^{NI,N_f})$, respectively, each of the channel estimates $(\mathcal{H}_n^1, \ldots, \mathcal{H}_n^{NI})$ comprising a respective one of the sets of sub-channel

vector estimates, each of the sets of sub-channel vector estimates representing an estimate of the channel parameters of N_f sub-channels of said channel between the base station and the transmitter of the corresponding one of the NI user stations in said first group, the constraints-set generator means (42E) comprises a plurality of respreaders $(57E^1,\ldots,57E^{NI})$ and a plurality of channel replicators $(59E^1,\ldots,59E^{NI})$ coupled to the plurality of respreaders $(57E^1,\ldots,57E^{NI})$, respectively, for filtering the plurality of respread symbols $(\hat{b}_n^1,\ldots,\hat{b}_n^{NI})$, respectively, using respective ones of the sub-channel vector estimates $(\hat{H}_n^{1,1},\ldots,\hat{H}_n^{1,N_f},\ldots,\hat{H}_n^{NI,1},\ldots,\hat{H}_n^{NI,N_f})$, to form a plurality *$(N_c)$* of constraints equal in number to *$N_f NI$* and forming a plurality of user-specific sub-channel observation matrix estimates $(\hat{Y}_{n-1}^{1,1},\ldots,\hat{Y}_{n-1}^{1,N_f},\ldots,\hat{Y}_{n-1}^{NI,1},\ldots,\hat{Y}_{n-1}^{NI,N_f})$ corresponding to the sub-channels, respectively, and, in the constraint matrix generator (43E), the bank of reshapers $(48A^1,\ldots,48A^{N_c})$ reshape the sets of user-specific observation matrix estimates to form a corresponding plurality of sets of user-specific sub-channel observation vector estimates $(\underline{\hat{Y}}_{n-1}^{1,1},\ldots,\underline{\hat{Y}}_{n-1}^{1,N_f},\ldots,\underline{\hat{Y}}_{n-1}^{NI,1},\ldots,\underline{\hat{Y}}_{n-1}^{NI,N_f})$ as respective columns of the constraint matrix $(\hat{C}_n)$ for supply to each of the coefficient tuning means $(50A^d)$ of each of said receiver modules (20^d) of said second group (D).

9. A receiver according to claim 3, further comprising hypothetical symbol estimate generating means $(63F^1,\ldots,63F^{NI})$ for generating for each of said selected ones of said components a series of hypothetical symbol estimates $(\underline{g}_n^1,\underline{g}_n^2,\underline{g}_n^3)$, wherein the constraints-set generating means (42F) comprises a plurality of respreaders $(57F^1,\ldots,57F^{NI})$ each for respreading, using a corresponding one of the user spreading codes, selected sets of said hypothetical symbol estimates, and a plurality of channel replicator means $(59F^1,\ldots,59F^{NI})$, respectively, for filtering the sets of respread symbol estimates, each to form a plurality *(N_c)* of constraints equal in number to *$3\ NI$* and forming a plurality of user-specific observation matrix estimates $(\hat{Y}_{0,n}^1,\hat{Y}_{-1,n}^1,\hat{Y}_{+1,n}^1,\ldots,\hat{Y}_{0,n}^{NI},\hat{Y}_{-1,n}^{NI},\hat{Y}_{+1,n}^{NI})$, the plurality of channel replication means $(59F^1,\ldots,59F^{NI})$ having coefficients adjustable in dependence upon the channel vector estimates $(\underline{\hat{H}}_n^1,\ldots,\underline{\hat{H}}_n^{NI})$, respectively, and, in the constraint matrix generating means (43F), the bank of reshapers $(48A^1,\ldots,48A^{N_c})$ reshape the sets of user-specific observation matrix estimates to form a plurality of user-specific observation vector estimates $(\underline{\hat{Y}}_{0,n}^1,\underline{\hat{Y}}_{-1,n}^1,\underline{\hat{Y}}_{+1,n}^1,\ldots,\underline{\hat{Y}}_{0,n}^{NI},\underline{\hat{Y}}_{-1,n}^{NI},\underline{\hat{Y}}_{+1,n}^{NI})$, respectively, as respective columns of the

constraint matrix $(\hat{C}_n)$ for supply to each of the coefficient tuning means ($50A^d$) of each of said receiver modules (20^d) of said second group (D).

10. A receiver according to claim 3, further comprising means ($63G^1,\ldots,63G^{NI}$) for providing hypothetical symbol estimates $(g_n^{l,+1,u})$ and wherein the constraints-set generating means uses a combination of said symbol estimates $(\hat{b}_n^1,\ldots,\hat{b}_n^{NI})$ and said hypothetical symbol values in producing said set of user-specific observation matrix estimates.

11. A receiver according to claim 10, wherein the constraints-set generating means (42G) comprises a plurality of respreaders ($57G^1,\ldots,57G^{NI}$) each for respreading, using a corresponding one of the user spreading codes, a respective one of the symbol estimates $(\hat{b}_n^1,\ldots,\hat{b}_n^{NI})$ and a said hypothetical symbol estimates $(g_n^{l,+1,u})$ to provide a plurality of respread symbol estimates, and a plurality of channel replicator means ($59G^1,\ldots,59G^{NI}$), respectively, for filtering the respread symbol estimates to form a plurality (N_c) of constraints equal in number to $2NI$ and forming a plurality of user-specific observation matrix estimates $(\hat{Y}_{r,n}^1, \hat{Y}_{+1,n}^1, \ldots, \hat{Y}_{r,n}^{NI}, \hat{Y}_{+1,n}^{NI})$, the plurality of channel replication means ($59F^1,\ldots,59F^{NI}$) having coefficients adjustable in dependence upon the channel vector estimates $(\underline{\hat{H}}_n^1,\ldots,\underline{\hat{H}}_n^{NI})$, respectively, and, in the constraint matrix generating means (43G), the bank of vector reshapers $(48A^1,\ldots,48A^{N_c})$ reshape the user-specific observation matrix estimates to form a corresponding plurality of user-specific observation vector estimates $(\underline{\hat{Y}}_{r,n}^1, \underline{\hat{Y}}_{+1,n}^1, \ldots, \underline{\hat{Y}}_{r,n}^{NI}, \underline{\hat{Y}}_{+1,n}^{NI})$, respectively, as respective columns of the constraint matrix $(\hat{C}_n)$ for supply to each of the coefficient tuning means ($50A^d$) of each of said receiver modules (20^d) of said second group (D).

12. A receiver according to claim 1, wherein the observation vector deriving means comprises a plurality of despreaders ($19^1,\ldots,19^{NI},19^d$) each for despreading the observation matrix (Y_n) using a corresponding one of the user spreading codes to produce a corresponding one of a plurality of post-correlation observation vectors $(\underline{Z}_n^1,\ldots,\underline{Z}_n^{NI}, \underline{Z}_n^d)$ and supplying the post-correlation observation vectors to both the channel identification means and the coefficient tuning means of the beamformer means of each of said one or more receiver modules, said elements of the observation vector weighted by said combining means of said one or more receiver modules being

elements of the corresponding post-correlation observation vector, and wherein the constraint matrix providing means (42B, 43B) comprises means (42B) responsive to said channel estimates $(\mathcal{H}_n^1,\dots,\mathcal{H}_n^{NI};\mathcal{H}_{n-1}^I)$ and to symbol estimates $(\hat{b}_n^1,\dots,\hat{b}_n^{NI};g^1,g^2,g^3;g^{I+1,n})$ corresponding to said first group (I) of user stations for providing a plurality of constraints-sets matrices (C_n) together characterizing the subspace of interference attributable to said spread signals of said first group of user stations, and constraint matrix generating means (43B) comprising a plurality of user-specific constraint matrix generators (43B^d) each associated with a respective one of said one or more receiver modules (20^d), each user-specific matrix generator (43B^d) having despreading means $(55B^{d,1},\dots,55B^{d,N_I})$ for using the corresponding user spreading code of the specific user to despread each of the user-specific constraints-set matrices respectively, to form a respective column of a corresponding one of a plurality of user-specific post-correlation constraint matrices $(\hat{C}^d_{PCM,n})$, the plurality of user-specific constraint matrix generating means (43B^d) supplying said plurality of user-specific post-correlation constraint matrices to the coefficient tuning means of the respective one of said one or more receiver modules (20B^d).

13. A receiver according to claim 12, further comprising means $(30^1,\dots,30^{NI})$ for deriving amplitude estimates $(\hat{\psi}_n^1,\dots,\hat{\psi}_n^{NI})$ of signal component estimates of said first group of user stations and supplying the amplitude estimates to said constraints-set generating means as parts of said channel estimates, and wherein the constraints-set generating means (42C) comprises a plurality of respreaders $(57C^1,\dots,57C^{NI})$ each for using a corresponding one of the user spreading codes to respread a respective one of the symbol estimates from receiver modules $(20^1,\dots,20^{NI})$ corresponding to said first group of user stations, scaling means $(58C^1,\dots,58C^{NI})$ for scaling each of the respread symbol estimates by said amplitudes $(\hat{\psi}_n^1,\dots,\hat{\psi}_n^{NI})$, respectively, a plurality of channel replication means $(59C^1,\dots,59C^{NI})$ having coefficients adjustable in dependence upon the channel vector estimates $(\underline{\hat{H}}_n^1,\dots,\underline{\hat{H}}_n^{NI})$, respectively, for filtering the corresponding respread and scaled symbol estimates to provide user-specific observation matrix estimates $(\hat{Y}_{n-1}^1,\dots,\hat{Y}_{n-1}^{NI})$, respectively, and means (60) for summing the user-specific observation matrix estimates to form an observation matrix estimate $(\hat{I}_{n-1})$ and supplying same to each of the user-specific constraint matrix generators (43H^d) of said one or more receiver modules of said second group, each of the user-specific constraint matrix

generators ($43H^d$) comprising despreading means ($55B^d$) for despreading the observation matrix estimate ($\hat{I}_{n-1}$) using the corresponding user spreading code to form a respective one ($\hat{I}^d_{PCM,n-1}$) of a plurality of post-correlation user-specific observation vector estimates each as a single column respective constraint matrix ($\hat{C}^d_{PCM,n}$), for use by the associated one of the coefficient tuning means ($50B^d$) in said second group (D).

14. A receiver according to claim 12, wherein the constraints-set generating means (42D) comprises a plurality of respreaders ($57D^1,\ldots,57D^{NI}$) each for respreading a respective one of the symbol estimates ($\hat{b}^1_n,\ldots,\hat{b}^{NI}_n$) from a predetermined group (I) of said receiver modules corresponding to said selected ones of said components of the received signals, and a plurality of channel replication means ($59D^1,\ldots,59D^{NI}$) having coefficients adjustable in dependence upon the channel vector estimates ($\underline{\hat{H}}^1_n,\ldots,\underline{\hat{H}}^{NI}_n$), respectively, for filtering the corresponding respread symbol estimates to provide a plurality of user-specific observation matrix estimates ($\hat{Y}^1_{n-1},\ldots,\hat{Y}^{NI}_{n-1}$) and wherein, in each of the user-specific constraint matrix generating means ($43I^d$), the despreading means ($55B^{d,1},\ldots,55B^{d,N_d}$) despreads the user-specific observation matrix estimates to form a plurality of user-specific observation vector estimates ($\underline{\hat{Y}}^1_{n-1},\ldots,\underline{\hat{Y}}^{NI}_{n-1}$) respectively, as respective columns of a respective user-specific constraint matrix ($\hat{C}_{PCM,n}$) for supply to the associated one of the coefficient tuning means ($50B^d$) of said one or more receiver modules (20^d) in said second group (D).

15. A receiver according to claim 12, wherein the plurality of channel identification means ($28^1,\ldots,28^{NI}$) of said first group (I) of receiver modules ($20E^1,\ldots,20E^{NI}$) generate both said channel vector estimates ($\underline{\hat{H}}^1_n,\ldots,\underline{\hat{H}}^{NI}_n$), respectively, and a plurality of sets of sub-channel vector estimates ($\hat{H}^{1,1}_n,\ldots,\hat{H}^{1,N_f}_n,\ldots,\hat{H}^{NI,1}_n,\ldots,\hat{H}^{NI,N_f}_n$), respectively, each of the channel vector estimates ($\underline{\hat{H}}^1_n,\ldots,\underline{\hat{H}}^{NI}_n$), comprising a respective one of the sets of sub-channel vector estimates, each of the sets of sub-channel vector estimates representing an estimate of the channel parameters of sub-channels of said channel between the base station and the transmitter of the corresponding user station, the constraints-set generator means (42E) comprises a plurality of respreaders ($57E^1,\ldots,57E^{NI}$) and a plurality of channel replicators ($59E^1,\ldots,59E^{NI}$) coupled to the plurality of respreaders ($57E^1,\ldots,57E^{NI}$), respectively, for filtering the plurality of respread symbols ($\hat{b}^1_n,\ldots,\hat{b}^{NI}_n$), respectively, of said first group using respective ones of the sub-channel

vector estimates $(\hat{H}_n^{1,1},...,\hat{H}_n^{1,N_f},...,\hat{H}_n^{NI,1},...,\hat{H}_n^{NI,N_f})$, to form a plurality of sets of user-specific observation matrix estimates $(\hat{Y}_{n-1}^{1,1}...,\hat{Y}_{n-1}^{1,N_f}, ..., \hat{Y}_{n-1}^{NI,1},...,\hat{Y}_{n-1}^{NI,N_f})$, the sets corresponding to the sub-channels, respectively, and, in each of the user-specific constraint matrix generators ($43K^d$), the despreading means $(55B^{d,1},...,55B^{d,N_c})$ despreads the sets of user-specific observation matrix estimates to form a corresponding plurality of sets of user-specific observation vector estimates $(\underline{\hat{I}}_{PCM,n-1}^{1,1}, ..., \underline{\hat{I}}_{PCM,n-1}^{d,NI,N_f})$, the sets forming respective columns of a respective user-specific constraint matrix $(\hat{C}_{PCM,n}^{d})$ for supply to the associated one of the coefficient tuning means ($50B^d$) of the one or more receiver modules (20^d) in said second group (D).

16. A receiver according to claim 12, further comprising hypothetical symbol estimate generating means ($63L^1$,...,$63L^{NI}$) for generating for each of said selected ones of said components a series of hypothetical symbol estimates (g_n^1, g_n^2, g_n^3), wherein the constraints-set generating means (42L) comprises respreading means ($57L^1$,...,$57L^{NI}$) for respreading, using a corresponding one of the user spreading codes for said first group, selected sets of said hypothetical symbol estimates, and channel replicator means ($59L^1$,...,$59L^{NI}$), respectively, for filtering the sets of respread hypothetical values, each to form one of a plurality of sets of user-specific observation matrix estimates $(\hat{Y}_{0,n}^{1}, \hat{Y}_{-1,n}^{1}, \hat{Y}_{-1,n}^{1}, ..., \hat{Y}_{0,n}^{NI}, \hat{Y}_{-1,n}^{NI}, \hat{Y}_{+1,n}^{NI})$, the plurality of channel replication means ($59L^1$,...,$59L^{NI}$) having coefficients adjustable in dependence upon the channel vector estimates $(\underline{\hat{H}}_n^1, ..., \underline{\hat{H}}_n^{NI})$, respectively, and, in each of the user-specific constraint matrix generating means ($43L^d$), the despreading means $(55B^{d,1},...,55B^{d,N_c})$ despreads the sets of user-specific observation matrix estimates to form a corresponding plurality of sets of user-specific observation vector estimates $(\underline{\hat{I}}_{PCM,n}^{d,1,1}, \underline{\hat{I}}_{PCM,n}^{d,1,2}, \underline{\hat{I}}_{PCM,n}^{d,1,3}, ..., \underline{\hat{I}}_{PCM,n}^{d,NI,1}, \underline{\hat{I}}_{PCM,n}^{d,NI,2}, \underline{\hat{I}}_{PCM,n}^{d,NI,3})$, respectively, as respective columns of a respective user-specific constraint matrix $(\hat{C}_{PCM,n}^{d})$ for supply to the coefficient tuning means ($50B^d$) of the associated one of said one or more receiver modules (20^d) in said second group (D).

17. A receiver according to claim 12, further comprising means ($63M^1$,...,$63M^{NI}$) for providing hypothetical symbol estimates $(g_n^{l,-1,n})$ and wherein the constraints-set generating means (42M) uses a combination of said symbol estimates $(\hat{b}_n^1,...,\hat{b}_n^{NI})$ and said hypothetical symbol estimates in producing said sets of user-specific observation matrix estimates.

18. A receiver according to claim 17, wherein the constraints-set generating means (42M) comprises a respreading means ($57M^1,\ldots,57M^{NI}$) for respreading, using the symbol estimates ($\hat{b}_n^1,\ldots,\hat{b}_n^{NI}$) and said hypothetical symbol estimates ($g_n^{l,u}$) using respective ones of the user spreading codes, to provide a plurality of respread symbol estimates, and channel replicator means ($59M^1,\ldots,59M^{NI}$) for filtering the respread symbol estimates to form a plurality of pairs of user-specific observation matrix estimates ($\hat{Y}^1_{r,n}, \hat{Y}^1_{+1,n},\ldots,\hat{Y}^{NI}_{r,n}, \hat{Y}^{NI}_{+1,n}$), each pair corresponding to one of said first group of user stations, the channel replication means ($59M^1,\ldots,59M^{NI}$) having coefficients adjustable in dependence upon the channel vector estimates ($\underline{\hat{H}}^1_n,\ldots,\underline{\hat{H}}^{NI}_n$), respectively, and, in each of the user-specific constraint matrix generating means ($43M^d$), the despreading means ($55B^{d,1},\ldots,55B^{d,N_c}$) despreads the user-specific observation matrix estimates to form a corresponding plurality of user-specific observation vector estimates ($\underline{\hat{Y}}^{d,1,k_1}_{PCM,n}, \underline{\hat{Y}}^{d,1,K_1}_{PCM,n},\ldots,\underline{\hat{Y}}^{d,NI,k_1}_{PCM,n}, \underline{\hat{Y}}^{d,NI,k_1}_{PCM,n}$), respectively, as respective columns of a corresponding user-specific constraint matrix ($\hat{C}_{PCM,n}$) for supply to the coefficient tuning means ($50B^d$) of the associated one of said one or more receiver modules (20^d) in said second group (D).

19. A receiver according to claim 1, wherein:

at least one (20^i) of said one or more receiver modules both supplies symbol estimates to said constraint-matrix generating means (42P,43P) for use in deriving said constraint matrices and uses said constraint matrices in tuning weighting coefficients of its beamformer means ($47P^i$),

said at least one of said one or more receiver modules further comprising a second beamformer means ($27P^i$) having second combining means and second coefficient tuning means for tuning the weighting coefficients of the second combining means;

the observation vector deriving means (19,44;44/1,44/2) further comprising second reshaping means (44/2) for reshaping said observation matrix (Y_n) and supplying a resulting second observation vector ($\underline{Y}_n$) to said second combining means ($27P^i$) and delay means (45) for delaying the first observation vector ($\underline{Y}_{n-1}$) relative to the second observation vector ($\underline{Y}_n$);

the second coefficient tuning means also being arranged to tune the weighting coefficients of the second combining means in dependence upon the channel vector

estimate $(\underline{\hat{Y}}^{i}_{0,n-1})$ used by the first coefficient tuning means in beamformer (47P^i); and wherein

the channel identification means (28P^i) of said at least one of the one or more receiver modules derives the channel vector estimate $(\underline{\hat{Y}}^{i}_{0,n-1})$ from the delayed first observation vector $(\underline{Y}_{n-1})$ and supplies said channel vector estimate to the respective coefficient tuning means of the first combining means and the second combining means for use in updating their weighting coefficients and supplies to the constraint matrix generator means (42P,43P) said channel estimates $(\hat{\mathcal{H}}^{i}_{n-1})$ for use in deriving the constraint matrix;

the first combining means (47P^i;51,52) and second combining means (27P^i;51,52) use their respective weighting coefficients to weight respective ones of the elements of the delayed first observation vector and the second observation vector, respectively, and combine the weighted elements of the respective first and second observation vectors to provide first signal component estimate $(\hat{s}^{i}_{n-1})$ and second signal component estimate $(\hat{s}^{i}_{MRC,n})$, respectively;

said at least one of said one or more receiver modules further comprises second symbol estimating means (29P/2^i) for deriving from the second signal component estimate $(\hat{s}^{i}_{MRC,n})$ a symbol estimate $(\hat{b}^{i}_{MRC,n})$ and supplying said symbol estimate $(\hat{b}^{i}_{MRC,n})$ to the constraint matrix providing means (42P,43P);

the constraint means (42P,43P) comprises constraints-set generating means (42P) for generating a plurality of constraints-set matrices (C_{n-1}) together characterizing the subspace of interference attributable to said first group of user station signals and the constraint matrix generating means (43P) comprises vector reshaping means $(48A^{1},\dots,48A^{N_c})$ for reshaping the constraints-set matrices $(C^{1}_{n},\dots,C^{N_c}_{n})$ to form columns, respectively, of the constraint matrix $(\hat{C}_{n-1})$, the constraint matrix generating means (43P) supplying the constraint matrix to each of said coefficient tuning means (50P^d) of said one or more receiver modules (20^d).

20. A receiver according to claim 19, wherein said at least one of said one or more receiver modules further comprises amplitude estimation means (30P^i) for providing amplitude estimates $(\hat{\psi}^{i}_{n-1})$ of signal components from said first group of user stations and supplying the amplitude estimates to the constraints-set generating means (42P) as parts of the channel estimates $(\hat{\mathcal{H}}^{i}_{n-1})$.

21. A receiver according to claim 19, wherein said at least one of the one or more receiver modules is arranged to perform for each frame a plurality of iterations (#1, #2, ..., $\#N_s$) to derive each symbol estimate, the arrangement being such that:

in each of the iterations of a particular frame (n), the constraints-set generator (42P) uses the channel estimates $(\mathcal{H}^i_{n-1})$, a first symbol estimate $(\hat{b}^i_{n-2})$ and a second symbol estimate $(\hat{b}^i_{MRC,n})$ from the first and second beamformer means, respectively of said one or more receiver modules,

in a first iteration, the constraint matrix providing means (42P,43P) generates a first-iteration constraint matrix $(\hat{C}_{n-1}(1))$ in dependence also upon a previous symbol estimate $(\hat{b}^i_{MRC,n-1})$ previously generated by each of said second beamformers of said one or more receiver modules and supplies said first-iteration constraint matrix $(\hat{C}_{n-1}(1))$ to the coefficient tuning means of the first beamformer means ($47P^i$) for use, with the spread channel estimate $\underline{\hat{Y}}^i_{0,n-1}$, to tune the coefficients of the first beamformer means ($47P^i$) for weighting each element of the delayed first observation vector $(\underline{Y}_{n-1})$ to produce a first-iteration signal component estimate and the decision rule unit ($29P/1^i$) processes said first-iteration signal component estimate to produce a first-iteration symbol estimate $(\hat{b}^i_{n-1}(1))$,

in a second iteration, the constraint matrix generating means (43P) uses said first-iteration symbol estimate $(\hat{b}^i_{n-1}(1))$, instead of the previous symbol estimate $(\hat{b}^i_{MRC,n-1})$ to tune the weighting coefficients and derive a second-iteration constraint matrix $(\hat{C}_{n-1}(2))$ for use by the first beamformer means and first decision rule means to produce a second-iteration symbol estimate $(\hat{b}^i_{n-1}(2))$, and

in a final iteration of a total of N_s iterations, the constraint matrix providing means (42P,43P) uses a penultimate-iteration symbol estimate $(\hat{b}^i_{n-1}(N_s-1))$ produced by the first decision rule means ($29P/1^i$) in the penultimate iteration to provide a final-iteration constraint matrix $(\hat{C}_{n-1}(N_s))$ for use by the first combining means and first decision rule means to provide a final iteration symbol estimate $(\hat{b}^i_{n-1}(N_s))$ as the target symbol estimate of that frame (u) for output as the symbol estimate $(\hat{b}^i_{n-1})$, and wherein the constraints-set generator (42P) buffers the symbol estimate $(\hat{b}^i_{n-1})$ for use in every iteration of the next frame $(n+1)$ instead of symbol estimate $\hat{b}^i_{n-2}$, and the constraints-set generator (42P) uses a new symbol estimate $(\hat{b}^i_{MRC,n+1})$ from said second beamformer ($27P^i$) for all iterations of the new frame, and uses the previous symbol estimate $(\hat{b}^i_{MRC,n})$ from said second beamformer means ($27P^i$) in only the first iteration

of said new frame, said previous symbol estimate being buffered as required and other variables being incremented appropriately.

22. A receiver according to claim 1, wherein said plurality of receiver modules ($20^1,\ldots,20^{N1},20^d$) comprises a first set (I) of receiver modules ($20^1,\ldots,20^{N1}$) for relatively strong user signals and that contribute at least respective sets of said channel estimates to said constraints-set generator (42) for use in deriving said constraint matrices but do not use said constraint matrices to update the weighting coefficients of their respective beamformer means, and a second set (D) of receiver modules (20^d) for relatively weaker user signals and that use the constraint matrices to update the weighting coefficients of their respective beamformer means but do not contribute either channel estimates or symbol estimates to the constraints-set generator (42) for use in deriving said constraint matrices.

23. A receiver according to claim 22, wherein said plurality of receiver modules further comprises at least one further set (M1) of at least one receiver module (20^i) as defined in claim 19 for a user signal having a signal strength that is intermediate the relatively strong and relatively weaker user signals and that both supplies at least channel estimates to said constraint-matrix generating means (42P,43P) for use by receiver modules in other sets in deriving said constraint matrices and uses said constraint matrices derived from constraints supplied by receiver modules in its own set in tuning weighting coefficients of its beamformer means ($47P^i$).

24. A receiver according to claim 22, wherein said plurality of receiver modules further comprises at least one further set (M2) of at least one receiver module (20^i) as defined in claim 19 for a user signal having a signal strength that is intermediate the relatively strong and relatively weaker user signals and that both supplies at least channel estimates to said constraint-matrix generating means (42P,43P) for use in deriving said constraint matrices and, in tuning weighting coefficients of its beamformer means ($47P^i$), uses said constraint matrices derived from constraints supplied by receiver modules in either or both of its own set and other sets.

25. A receiver according to claim 23, wherein the receiver modules are arranged in hierarchical order according to signal power and each lower power receiver module uses a constraint matrix formed from constraints-sets supplied by each of the higher power receiver modules.

26. A receiver according to claim 24, wherein the receiver modules are arranged in hierarchical order according to signal power and each lower power receiver module uses a constraint matrix formed from constraints-sets supplied by each of the higher power receiver modules.

27. A receiver according to claim 23, wherein each of the receiver modules in one of said sets is different from the receiver modules in the other sets.

28. A receiver according to claim 23, wherein the receiver modules in one of said second and further sets of receiver modules differ from each other.

29. A receiver according to claim 3, wherein said beamformer means of said at least one of the one or more receiver modules comprise projector means (100^d) for multiplying a projection (Π_n^d) with the observation vector ($\underline{Y}_n$) to form an interference-reduced observation vector ($\underline{Y}_n^{\Pi,d}$), and a residual beamformer ($27Q^d$) responsive to the projection (Π_n^d) and to the channel vector estimate ($\hat{\underline{Y}}_{0,n}^d$) to produce said signal component estimate ($\hat{s}_n^d$), and the channel identification means ($28Q^d$) derives the channel vector estimate ($\hat{\underline{Y}}_{0,n}^d$) from the interference-reduced observation vector ($\underline{Y}_n^{\Pi,d}$).

30. A receiver according to claim 29, wherein said at least one of the one or more receiver modules further comprises reshaping means ($102Q^d$) for reshaping the interference-reduced observation vector ($\underline{Y}_n^{\Pi,d}$) to form an interference-reduced observation matrix ($Y_n^{\Pi,d}$), and a despreader (19^d) for despreading the interference-reduced observation matrix ($Y_n^{\Pi,d}$), with the corresponding user spreading code to form a post-correlation reduced-interference observation vector ($\underline{Z}_n^{\Pi,d}$) for use by the channel identification means (28Qd) in deriving said channel vector estimate.

31. A receiver according to claim 3, for a base station in a CDMA system in which at least one of the user stations uses a plurality of different spreading codes to spread respective ones of said series of symbols for simultaneous transmission, such that the component of the received signal (X(t)) corresponding to that user station comprises a corresponding plurality of spread signals, and wherein, in said at least one of the one or more receiver modules (20^d), said beamformer means $(47R^{d,1},\ldots,47R^{d,N_m})$ uses different sets of weighting coefficients to weight each element of said observation vector $(\underline{Y}_n)$ to form a plurality of signal component estimates $(\hat{s}_n^{d,1},\ldots,\hat{s}_n^{d,N_m})$ corresponding to said respective ones of said series of symbols and the symbol estimating means derives from the plurality of signal component estimates $(\hat{s}_n^{d,1},\ldots,\hat{s}_n^{d,N_m})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{d,1},\ldots,\hat{b}_n^{d,N_m})$, said observation vector deriving means comprises means $(19^{d,1},\ldots,19^{d,N_m})$ for deriving from the observation matrix a plurality of post-correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,N_m})$ each corresponding to a respective one of the plurality of different spreading codes, the channel identification means ($28R^d$) derives from said plurality of post-correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,N_m})$ a corresponding plurality of sets of channel vector estimates $(\hat{\underline{Y}}_{0,n},\ldots,\hat{\underline{Y}}_{0,n}^{d,N_m})$ and supplies the sets to said beamformer means $(47R^{d,1},\ldots,47R^{d,N_m})$ and the coefficient tuning means of the beamformer means $(47R^{d,1},\ldots,47R^{d,N_m})$ uses the sets of channel vector estimates $(\hat{\underline{Y}}_{0,n},\ldots,\hat{\underline{Y}}_{0,n}^{d,N_m})$ to derive said different sets of weighting coefficients, respectively.

32. A receiver according to claim 31, wherein the means $(19^{d,1},\ldots,19^{d,N_m})$ for deriving the plurality of observation vectors comprises despreading means for despreading said observation matrix (Y_n) using one or more of said plurality of different spreading codes to form a plurality of post-correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,N_m})$ for use by the channel identification means ($28R^d$) in deriving said plurality of spread channel vector estimates $(\hat{\underline{Y}}_{0,n}^{d,1},\ldots,\hat{\underline{Y}}_{0,n}^{d,N_m})$.

33. A receiver according to claim 32, wherein the observation vector deriving means further comprises also supplies said plurality of post-correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,N_m})$ to said beamformer means $(47R^{d,1},\ldots,47R^{d,N_m})$, and the coefficient tuning means therein uses said sets of weighting coefficients to weight elements of respective ones of the plurality of post-correlation observation vectors, and

each of the user-specific constraint-matrix generator means comprises despreading means $(55B^{d,1},\ldots,55B^{d,N_m})$ for despreading the user-specific constraints-set matrices using one or more of the plurality of different spreading codes.

34. A receiver according to claim 31, wherein said means for deriving said plurality of observation vectors comprises despreading means $(19^{d,\delta})$ for weighting said plurality of different spreading codes by the plurality of symbol estimates $(\hat{b}_n^{d,1},\ldots,\hat{b}_n^{d,N_m})$, respectively, to form a single spreading code and despreading the observation matrix (Y_n) using said single spreading code to produce a compound post-correlation observation vector $(Z_n^{d,\delta})$ for use by the channel identification means ($28R^d$) to derive said plurality of sets of channel vector estimates $(\hat{Y}_{0,n},\ldots,\hat{Y}_{0,n}^{d,N_m})$.

35. A receiver according to claim 34, wherein the observation vector deriving means also supplies said plurality of post-correlation observation vectors $(Z_n^{d,1},\ldots,Z_n^{d,N_m})$ to said beamformer means $(47R^{d,1},\ldots,47R^{d,N_m})$, and the coefficient tuning means therein uses said sets of weighting coefficients to weight elements of respective ones of the plurality of post-correlation observation vectors, and each of the user-specific constraint-matrix generator means comprises despreading means $(55B^{d,1},\ldots,55B^{d,N_m})$ for despreading the user-specific constraints-set matrices using the plurality of different spreading codes.

36. A receiver according to claim 3, wherein each of said plurality of receiver modules ($20^1,\ldots,20^{NI},20^d$) operates with a frame duration equal to integer multiples ($F_1,\ldots,F_{NI},F_d$) of symbol periods of the corresponding users and uses a plurality ($F_1,\ldots,F_{NI},F_d$) of different segments of the same long spreading code equal to said the number of symbol periods in said frame, in said at least one of the one or more receiver modules (20^d), said beamformer means $(47S^{d,1},\ldots,47S^{d,F_d})$ uses different sets of weighting coefficients to weight each element of said observation vector (Y_n) to form a plurality (F_d) of signal component estimates $(\hat{s}_n^{d,1},\ldots,\hat{s}_n^{d,F_d})$, respectively, and the symbol estimating means $(29S^{d,1},\ldots,29S^{d,F_d})$ derives from the plurality of signal component estimates $(\hat{s}_n^{d,1},\ldots,\hat{s}_n^{d,F_d})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{d,1},\ldots,\hat{b}_n^{d,F_d})$, said observation vector deriving means deriving from the observation matrix one or more of a plurality of post-correlation observation vectors $(Z_n^{d,1},\ldots,Z_n^{d,F_d})$ the channel identification means ($28S^d$) derives from said post-

correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,F_d})$ a corresponding plurality of spread channel vector estimates $(\hat{\underline{Y}}_{0,n}^{d,1},\ldots,\hat{\underline{Y}}_{0,n}^{d,F_d})$, and supplies said spread channel vector estimates $(\hat{\underline{Y}}_{0,n}^{d,1},\ldots,\hat{\underline{Y}}_{0,n}^{d,F_d})$, to said beamformer means $(47S^{d,1},\ldots,47S^{d,F_d})$, each spread channel vector estimate being spread by a respective one of the segments of the long spreading code, and the coefficient tuning means of the beamformer means $(47S^{d,1},\ldots,47S^{d,F_d})$ uses said channel vector estimates $(\hat{\underline{Y}}_{0,n}^{d,1},\ldots,\hat{\underline{Y}}_{0,n}^{d,F_d})$ to derive said different sets of weighting coefficients.

37. A receiver according to claim 36, wherein the means $(19S^{d,1},\ldots,19S^{d,F_d})$ for deriving one or more of the plurality of post-correlation observation vectors comprises despreading means for despreading said observation matrix (Y_n) using one or more of said different segments of the same long spreading code such that said plurality of observation vectors comprise a plurality of post-correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,F_d})$ one or more thereof for use by the channel identification means $(28S^d)$.

38. A receiver according to claim 37, wherein the observation vector deriving means also supplies said plurality of post-correlation observation vectors $(\underline{Z}_n^{d,1},\ldots,\underline{Z}_n^{d,F_d})$ to said beamformer means $(47S^{d,1},\ldots,47S^{d,F_d})$, and the coefficient tuning means therein uses said sets of weighting coefficients to weight elements of respective ones of the plurality of post-correlation observation vectors, and each of the user-specific constraint-matrix generator means comprises despreading means $(55B^{d,1},\ldots,55B^{d,F_d})$ for despreading the user-specific constraints-set matrices using the corresponding one of the plurality (F_d) of different spreading code segments.

39. A user station receiver for a CDMA communications system comprising a plurality (NB) of base stations (11) and a multiplicity (U) of user stations $(10^1,\ldots,10^U)$, at least a plurality (U′) of the user stations being in a cell associated with one of said base stations and served thereby, said one base station having a plurality of transmitter modules for spreading user signals for transmission to the plurality (U′) of user stations, respectively, and a receiver for receiving spread user signals transmitted by the plurality (U′) of user stations, the user stations each having a receiver for receiving the corresponding spread user signal transmitted by the base station, said plurality (U′) of

user stations each having a unique spreading code assigned thereto for use by the user station and the corresponding one of the base station transmitter modules to spread the user signals of that user for transmission,

the spread user signals transmitted from the base station transmitter modules to a particular one of the plurality (U') of user stations propagating via a plurality of channels ($14^1,\ldots,14^{U'}$), respectively,

the receiver of a particular one of said plurality (U') of user stations receiving a signal (X(t)) comprising components corresponding to spread user signals for said particular user station and spread user signals transmitted by other transmitter modules of said plurality (NB) of base stations for other users, each of said spread user signals comprising a series of symbols spread using the spreading code associated with the corresponding one of the user stations,

said user station receiver comprising:

a plurality (NB) of receiver modules ($20^{v'}$) each for deriving from successive frames of the received signal (X(t)) estimates of sets of said series of symbols from a corresponding one of the base stations,

preprocessing means (18) for deriving from the received signal (X(t)) a series of observation matrices (Y_n) each for use by each of the receiver modules ($20^{v'}$) in a said frame to derive estimates of sets of said symbols, and

means (19,44) for deriving from each observation matrix a plurality of sets of observation vectors $(\underline{Y}_n^{v',1,1},\ldots,\underline{Y}_n^{v',NI,F_{NI}};\ \underline{Z}_n^{v',1,1},\ldots,\underline{Z}_n^{v',NI,F_{NI}})$ and applying each of the sets of observation vectors to a respective one of the plurality of receiver modules ($20^{v'}$);

each receiver modules comprising;

channel identification means ($28T^{v'}$) for deriving from the respective one of the sets of observation vectors a set of spread channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},\ldots,\hat{\underline{Y}}_{0,n}^{v',NI,F_{NI}})$ based upon parameter estimates of the channel between the corresponding one of the base stations and said user station;

beamformer means $(47T^{v',1,1},\ldots,47T^{v',NI,F_{NI}})$ having coefficient tuning means for producing sets of weighting coefficients in dependence upon the sets of channel vector estimates, respectively, and combining means for using each of the sets of weighting coefficients to weight respective ones

of the elements of a respective one of the observation vectors and combining the weighted elements to provide a corresponding set of signal component estimates $(\hat{s}_n^{v',1,1},\ldots,\hat{s}_n^{v',NI,F_{NI}})$ and

symbol estimating means $(29T^{v',1,1},\ldots,29T^{v',NI,F_{NI}})$ for deriving from the set of signal component estimates a set of estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,F_{NI}})$ of symbols spread by the corresponding one of the transmitter modules and transmitted by the base station;

said user station receiver further comprising means (42,43) responsive to said symbol estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,F_{NI}};\hat{g}_n^1,\hat{g}_n^2,\hat{g}_n^3)$ and channel estimates $(\mathcal{H}_n^{v'})$ from each of said plurality (NB) of receiver modules, said channel estimates comprising at least channel vector estimates $(\hat{H}_n^{v'})$ for channels $(14^{v'})$ between the user station receiver and said base stations, for providing at least one constraint matrix $(\hat{C}_n)$ representing interference subspace of components of the received signal corresponding to said spread signals, and in each of said receiver modules $(20^{v'})$, the coefficient tuning means produces said sets of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_n)$ and the channel vector estimates so as to tune said receiver module $(20^{v'})$ towards a substantially null response to that portion of the received signal (X(t)) corresponding to said interference subspace.

47 ~~40~~. A user station receiver according to claim ~~39~~ 46, wherein said observation vector deriving means comprises means $(19^{v',1,1},\ldots,19^{v',NI,F_{NI}})$ for deriving from the observation matrix a plurality of post-correlation observation vectors $(Z_n^{v',1,1},\ldots,Z_n^{v',NI,F_{NI}})$ and supplying said plurality of post-correlation observation vectors $(Z_n^{v',1,1},\ldots,Z_n^{v',NI,F_{NI}})$ to the channel identification means $(28T^{v'})$ for use in producing said sets of channel vector estimates $(\hat{Y}_{0,n}^{v',1,1},\ldots,\hat{Y}_{0,n}^{v',NI,F_{NI}})$.

48 ~~41~~. A user station receiver according to claim ~~39~~ 46, wherein said plurality (NB) of receiver modules $(20^{v'})$ derive symbols for user signals other than those destined for the user of said user station receiver, and said user station receiver comprises an additional receiver module (20^{d}) for deriving symbols from the received signal destined for said user of said user station receiver and transmitted by a corresponding serving one (v) of said plurality of base stations, wherein each of said plurality of receiver modules

($20^{v'}$,20^{d}) operates with a frame duration equal to an integer multiple of the symbol period and uses a corresponding number of segments ($F_1,\ldots,F_{NI},F_d$) of a long spreading code, each segment corresponding to a respective one of a plurality ($F_1,\ldots,F_{NI},F_d$) of different segments of the same long spreading code equal to said plurality of symbol periods in said frame, and wherein, in said additional receiver module (20^{d}), said beamformer means ($47S^{d,1},\ldots,47S^{d,F_d}$) uses different sets of weighting coefficients to weight each element of said observation vector ($\underline{Y}_n$) to form a plurality (F_d) of signal component estimates ($\hat{s}_n^{d,1},\ldots,\hat{s}_n^{d,F_d}$), respectively, and the symbol estimating means ($29S^{d,1},\ldots,29S^{d,F_d}$) derives from the plurality of signal component estimates ($\hat{s}_n^{d,1},\ldots,\hat{s}_n^{d,F_d}$) a corresponding plurality of symbol estimates ($\hat{b}_n^{d,1},\ldots,\hat{b}_n^{d,F_d}$), said observation vector deriving means deriving from the observation matrix a plurality of observation vectors ($\underline{Y}_n^{d,1},\ldots,\underline{Y}_n^{d,F_d}$) the channel identification means ($28S^{d}$) derives from said observation vectors ($\underline{Y}_n^{d,1},\ldots,\underline{Y}_n^{d,F_d}$) a corresponding plurality of spread channel vector estimates ($\hat{\underline{Y}}_{0,n},\ldots,\hat{\underline{Y}}_{0,n}^{d,F_d}$), and supplies same said beamformer means ($47S^{d,1},\ldots,47S^{d,F_d}$), each spread channel vector estimate being spread by a respective one of the segments of the long spreading code, and the coefficient tuning means of the beamformer means ($47S^{d,1},\ldots,47S^{d,F_d}$) uses said channel vector estimates ($\hat{\underline{Y}}_{0,n}^{d,1},\ldots,\hat{\underline{Y}}_{0,n}^{d,F_d}$) to derive said different sets of weighting coefficients.

49 ~~42.~~ A user station receiver according to claim ~~39~~ 46, wherein said plurality (NB) of receiver modules ($20^{v'}$) derive symbols for user signals other than those destined for the user of said user station receiver, and said user station receiver comprises an additional receiver module (20^{d}) for deriving symbols from the received signal destined for said user of said user station receiver, wherein each of said plurality of receiver modules ($20^{v'}$,20^{d}) operates with a frame duration equal to an integer multiple of the symbol period and uses a corresponding number of segments of a long spreading code, each segment corresponding to a respective one of a plurality ($F_1,\ldots,F_{NI},F_d$) of different segments of the same long spreading code equal to said plurality of symbol periods in said frame, and wherein, in said additional receiver module (20^{d}), said beamformer means ($47T^{v,d,1},\ldots,47T^{v,d,F_d}$) uses different sets of weighting coefficients to weight each element of said observation vector ($\underline{Y}_n$) to form a plurality (F_d) of signal component estimates ($\hat{s}_n^{v,d,1},\ldots,\hat{s}_n^{v,d,F_d}$), respectively, and the symbol estimating means ($29T^{v,d,1},\ldots,29T^{v,d,F_d}$) derives from the plurality of signal component estimates

$(\hat{s}_n^{v,d,1},\ldots,\hat{s}_n^{v,d,F_d})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{v,d,1},\ldots,\hat{b}_n^{v,d,F_d})$, and wherein the coefficient tuning means of said beamformer means $(47T^{v,d,1},\ldots,47T^{v,d,F_d})$ derives the weighting coefficients using said constraint matrix received from the constraint matrix generating means (43T) and said spread channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v,d,1},\ldots,\hat{\underline{Y}}_{0,n}^{v,d,F_d})$ produced by the channel identification means (28T') of the receiver module (20^{v}) corresponding to the base station (v) serving said user station.

50 ~~43~~. A user station receiver according to claim 49 ~~42~~, wherein said observation vector deriving means comprises despreading means $(19^{v',1,1},\ldots,19^{v',NI,F_{NI}})$ for despreading the observation matrix to form a plurality of post-correlation observation vectors $(\underline{Z}_n^{v',1,1},\ldots,\underline{Z}_n^{v',NI,F_{NI}})$ and supplying said plurality of post-correlation observation vectors $(\underline{Z}_n^{v',1,1},\ldots,\underline{Z}_n^{v',NI,F_{NI}})$ to the channel identification means (28T') for use in producing said sets of channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},\ldots,\hat{\underline{Y}}_{0,n}^{v',NI,F_{NI}})$.

51 ~~44~~. A user station receiver according to claim 46 ~~39~~, wherein at least one said transmitter module of one of the base stations uses a plurality (N_m) of different spreading codes to spread respective ones of said series of symbols for simultaneous transmission in the same frame, such that the component of the received signal (X(t)) corresponding to that base station transmitter module comprises a corresponding plurality of spread signals, and at least one (20$^{v'}$) of the plurality of receiver modules (20U) further comprises amplitude estimation means (30U$^{v'}$) for deriving total amplitude of a set of signal component estimates $(\hat{s}_n^{v',1,1},\ldots,\hat{s}_n^{v',NI,N_m})$ produced by beamformer means $(47U^{v',1,1},\ldots,47U^{v',NI,N_m})$ thereof, said beamformer means $(47U^{v',1,1},\ldots,47U^{v',NI,N_m})$ uses different sets of weighting coefficients to weight each element of said observation vector $(\underline{Y}_n)$ to form said plurality of signal component estimates $(\hat{s}_n^{v',1,1},\ldots,\hat{s}_n^{v',NI,N_m})$ corresponding to said respective ones of said series of symbols, and the symbol estimating means $(29U^{v',1,1},\ldots,29U^{v',NI,N_m})$ derives from the plurality of signal component estimates $(\hat{s}_n^{v',1,1},\ldots,\hat{s}_n^{v',NI,N_m})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,N_m})$, the channel identification means (28U$^{v'}$) derives a corresponding plurality of sets of spread channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},\ldots,\hat{\underline{Y}}_{0,n}^{v',NI,N_m})$ each spread by a respective one of said plurality of different spreading codes, and supplies the sets to said beamformer

means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ and the coefficient tuning means of the beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ uses the sets of spread channel vector estimates $(\underline{Y}_{0,n}^{v',1,1},...,\underline{Y}_{0,n}^{v',NI,N_m})$ to derive said different sets of weighting coefficients, respectively.

52

~~45.~~ A user station receiver according to claim ~~44~~ 51, wherein said plurality (NB) of receiver modules $(20^{v'})$ derive symbols for user signals other than those destined for the user of said user station receiver, and said user station receiver comprises an additional receiver module (20^{d}) for deriving symbols from the received signal destined for said user of said user station receiver, wherein each of said plurality of receiver modules $(20^{v'},20^{d})$ operates with a frame duration equal to an integer multiple of the symbol period and uses a corresponding number of segments of a long spreading code, each segment corresponding to a respective one of a plurality (N_m,F_d) of different segments of the same long spreading code equal to said plurality of symbol periods in said frame, and wherein, in said additional receiver module (20^{d}), said beamformer means $(47T^{v,d,1},..., 47T^{v,d,F_d})$ uses different sets of weighting coefficients to weight each element of said observation vector $(\underline{Y}_n)$ to form a plurality (F_d) of signal component estimates $(\hat{s}_n^{v,d,1},...,\hat{s}_n^{v,d,F_d})$, respectively, and the symbol estimating means $(29T^{v,d,1},...,29T^{v,d,F_d})$ derives from the plurality of signal component estimates $(\hat{s}_n^{v,d,1},...,\hat{s}_n^{v,d,F_d})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{v,d,1},...,\hat{b}_n^{v,d,F_d})$, and wherein the coefficient tuning means of said beamformer means $(47T^{v,d,1},..., 47T^{v,d,F_d})$ derives the weighting coefficients using said constraint matrix received from the constraint matrix generating means (43T) and said spread channel vector estimates $(\underline{Y}_{0,n}^{v,d,1},...,\underline{Y}_{0,n}^{v,d,F_d})$ produced by the channel identification means $(28T^{v})$ of the receiver module (20^{v}) corresponding to the base station (v) serving said user station.

53

~~46.~~ A receiver according to claim ~~44~~ 51, wherein said observation vector deriving means comprises despreading means $(19^{v',1,1},...,19^{v',NI,N_m})$ for despreading the observation matrix to form a plurality of post-correlation observation vectors $(\underline{Z}_n^{v',1,1},...,\underline{Z}_n^{v',NI,N_m})$ and supplying said plurality of post-correlation observation vectors $(\underline{Z}_n^{v',1,1},...,\underline{Z}_n^{v',NI,N_m})$ to the channel identification means $(28U^{v'})$ for use in producing said sets of channel vector estimates $(\underline{Y}_{0,n}^{v',1,1},...,\underline{Y}_{0,n}^{v',NI,N_m})$.

54 ~~47~~. A user station receiver according to claim 46 ~~39~~, wherein at least one said transmitter module of one of the base stations uses a plurality (N_m) of different spreading codes to spread respective ones of said series of symbols for simultaneous transmission in the same frame, such that the component of the received signal (X(t)) corresponding to that base station transmitter module comprises a corresponding plurality of spread signals, and at least one (20U′) of the plurality of receiver modules further comprises amplitude estimation means ($30U^{v}$) for deriving total amplitudes $(\psi_n^{v',1},...,\psi_n^{v',NI})$ of a set of signal component estimates $(\hat{s}_n^{v',1,1},...,\hat{s}_n^{v',NI,N_m})$ produced by beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ thereof, said beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ uses different sets of weighting coefficients to weight each element of said observation vector $(\underline{Y}_n)$ to form said plurality of signal component estimates $(\hat{s}_n^{v',1,1},...,\hat{s}_n^{v',NI,N_m})$ corresponding to said respective ones of said series of symbols and the symbol estimating means $(29U^{v',1,1},...,29U^{v',NI,N_m})$ derives from the plurality of signal component estimates $(\hat{s}_n^{v',1,1},...,\hat{s}_n^{v',NI,N_m})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{v',1,1},...,\hat{b}_n^{v',NI,N_m})$, said observation vector deriving means comprises despreading means $(19^{v',\Sigma,1},...,19^{v',\Sigma,N_m})$ for despreading the observation matrix (Y_n), using one or more of said plurality (N_m) of different spreading codes, each of these codes being a compound code formed by averaging the codes of all others of said multiplicity of interfering users (NI), to form a plurality of observation vectors $(\underline{Z}_n^{v',\Sigma,1},...,\underline{Z}_n^{v',\Sigma,N_m})$, the channel identification means ($28U^{v}$) derives from said plurality of observation vectors $(\underline{Z}_n^{v',\Sigma,1},...,\underline{Z}_n^{v',\Sigma,N_m})$, said signal component estimates $(\hat{s}_n^{v',\Sigma,1},...,\hat{s}_n^{v',\Sigma,N_m})$ and said amplitudes $(\psi_n^{v',1},...,\psi_n^{v',NI})$ a corresponding plurality of sets of channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},...,\hat{\underline{Y}}_{0,n}^{v',NI,N_m})$ and supplies the sets to said beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ and the coefficient tuning means of the beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ uses the sets of channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},...,\hat{\underline{Y}}_{0,n}^{v',NI,N_m})$ to derive said different sets of weighting coefficients, respectively.

40 ~~48~~. A receiver according to claim 1, each said receiver module it located in a user/mobile station and the received signal comprises a plurality of spread user signals transmitted by a plurality of transmitter modules at a base station communicating with said receiver via said channels.

each pilot signal being assigned a fixed fraction of the total power transmitted from the base station transmitter;

means for mapping the signals from the groups $(G_1(t), \cdots, G_{N_o}(t))$ onto antenna branches $(A_1(t), \cdots, A_{N_T}(t))$ by means of a linear space coding (M) such that signals assigned to different groups are substantially orthogonal at transmission;

at least one of the user stations having a receiver for receiving the corresponding spread user signal transmitted by the base station, said plurality (U′) of user stations each having a unique spreading code assigned thereto for use by the user station and the corresponding one of the base station transmitter modules to spread the user signals of that user for transmission,

the spread user signals transmitted from the base station transmitter modules to a particular one of the plurality (U′) of user stations propagating via a plurality of channels ($14^1, \ldots, 14^{U'}$), respectively,

the receiver of a particular one of said plurality (U′) of user stations receiving a signal (X(t)) comprising components corresponding to spread user signals for said particular user station and spread user signals transmitted by other transmitter modules of said plurality (NB) of base stations for other users, each of said spread user signals comprising a series of symbols spread using the spreading code associated with the corresponding one of the user stations,

said user station receiver comprising:

a plurality (NB) of receiver modules ($20^{v'}$) each for deriving from successive frames of the received signal (X(t)) estimates of sets of said series of symbols from a corresponding one of the base stations,

preprocessing means (18) for deriving from the received signal (X(t)) a series of observation matrices (Y_n) each for use by each of the receiver modules ($20^{v'}$) in a said frame to derive estimates of sets of said symbols, and

means (19,44) for deriving from each observation matrix a plurality of sets of observation vectors $(\underline{Y}_n^{v',1,1}, \ldots, \underline{Y}_n^{v',NIF_{v'}}; \underline{Z}_n^{v',1,1}, \ldots, \underline{Z}_n^{v',NIF_{v'}})$ and applying each of the sets of observation vectors to a respective one of the plurality of receiver modules ($20^{v'}$);

each receiver module comprising;

channel identification means ($28T^{v'}$) for deriving from the respective one of the sets of observation vectors a set of spread channel vector

estimates $(\underline{Y}_{0,n}^{v',1,1},\ldots,\underline{Y}_{0,n}^{v',NI,F_{NI}})$ based upon parameter estimates of the channel between the corresponding one of the base stations and said user station;

beamformer means $(47T^{v',1,1},\ldots,47T^{v',NI,F_{NI}})$ having coefficient tuning means for producing sets of weighting coefficients in dependence upon the sets of channel vector estimates, respectively, and combining means for using each of the sets of weighting coefficients to weight respective ones of the elements of a respective one of the observation vectors and combining the weighted elements to provide a corresponding set of signal component estimates $(\hat{s}_n^{v',1,1},\ldots,\hat{s}_n^{v',NI,F_{NI}})$ and

symbol estimating means $(29T^{v',1,1},\ldots,29T^{v',NI,F_{NI}})$ for deriving from the set of signal component estimates a set of estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,F_{NI}})$ of symbols spread by the corresponding one of the transmitter modules and transmitted by the base station;

said user station receiver further comprising means (42,43) responsive to said symbol estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,F_{NI}};g_n^1,g_n^2,g_n^3)$ and channel estimates $(\mathcal{H}_n^{v'})$ from each of said plurality (NB) of receiver modules, said channel estimates comprising at least channel vector estimates $(\underline{\hat{H}}_n^{v'})$ for channels $(14^{v'})$ between the user station receiver and said base stations, for providing at least one constraint matrix $(\hat{C}_n)$ representing interference subspace of components of the received signal corresponding to said spread signals, and in each of said receiver modules $(20^{v'})$, the coefficient tuning means produces said sets of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_n)$ and the channel vector estimates so as to tune said receiver module $(20^{v'})$ towards a substantially null response to that portion of the received signal (X(t)) corresponding to said interference subspace.

63 ~~51~~. A CDMA system according to claim 62 ~~50~~, the transmitter further comprising:

delay means for delaying the signals from the mapping means each by a branch-specific delay, forming a corresponding signalling pulse modulating the signalling pulse with a carrier frequency signal, and supplying the modulated signal to the antenna elements for transmission thereby.

64 ~~52~~. A CDMA system according to claim ~~50~~ 62, wherein, in the transmitter, the grouping means is arranged to group data signals dedicated for user stations into a predetermined number N_G of groups and, when the number of users is less than or equal to the processing gain, assigning all user signals to the same group; otherwise assigning user signals pseudo-randomly so as to tend to balance the number of users in each group.

65 ~~53~~. A CDMA system according to claim ~~50~~ 62, wherein the transmitter further comprises, for each group, a space-time coding means comprising:

a channel coding unit for spreading user signals by a group specific set of orthogonal codes;

a scrambling unit for spreading each group of user signals with the same base station specific scrambling code; and

a spatial coding unit for mapping the total group signals $(G_1(t), \cdots, G_{N_G}(t))$ onto the antenna branch signals $(A_1(t), \cdots, A_{N_0}(t))$ by a linear transformation (M).

66 ~~54~~. A CDMA system according to claim ~~53~~ 65, wherein, in the transmitter, the channel coding unit assigns to each user in the group indexed g a chip-code chosen from a fixed set of $L_g \leq L$ orthogonal group specific L-chip codes $(a_{i,1}(t), \cdots, a_{i,L_g}(t))$. , the code-sets across groups being chosen subject to minimize the maximum cross-correlation, any code belonging to any group being orthogonal to any other code within the group while its cross-correlation with any out-group channelization code is minimized.

67 ~~55~~. A CDMA communications system comprising at least one base station and a multiplicity (U) of user stations $(10^1, \cdots, 10^U)$ including a plurality (U') of user stations served by said at least one base station, each user station having a transmitter and a receiver for communicating with said at least one base station via a corresponding one of a plurality of channels $(14^1, \ldots, 14^U)$, at least one user station being capable of transmitting a user signal comprising a plurality of unique space-time encoded signals each carrying different data from that same user,

said at least one user station having a transmitter comprising:

a plurality of transmission antennas;

means for providing said user signals;

a distribution unit for grouping the space-time encoded signals into N_G groups;

a temporal channelization-code unit for spreading each different data stream of the user signals by a unique dedicated code belonging to a fixed set of L orthogonal codes and summing the spread signals in each group;

means for adding to the summed spread signals of each group a respective one of a plurality of pilot signals each specific to one of the groups and generated by a PN code generator;

each pilot signal being assigned a fixed fraction of the total power transmitted from the base station transmitter;

means for scrambling the summed signals from the groups using the same long scrambling code specific to the user station;

means for mapping the signals from the groups $(G_1(t),\cdots, G_{N_o}(t))$ onto antenna branches $(A_1(t),\cdots,A_{M_T}(t))$ by means of a linear space coding (M) such that signals assigned to different groups are substantially orthogonal at transmission;

the base station having a receiver for receiving a signal (X(t)) comprising components corresponding to spread signals transmitted by the transmitters of the plurality of user stations, each of said spread signals comprising a series of symbols spread using a spreading code unique to the corresponding user station, said base station receiver comprising:

a plurality (U′) of receiver modules $(20^1,\ldots,20^{NI},20^d)$ each for deriving from successive frames of the received signal (X(t)) estimates of said series of symbols of a corresponding one of the user stations,

preprocessing means (18) for deriving from the received signal (X(t)) a series of observation matrices (Y_n) each for use by each of the receiver modules (20) in a said frame to derive an estimate of a symbol of a respective one of said series of symbols, and

means (19,44;44/1,44/2) for deriving from each observation matrix a plurality of observation vectors $(\underline{Y}_n; \underline{Y}_{n-1}; \underline{Z}_n^1 .. \underline{Z}_n^{NI}; \underline{Z}_n^d)$ and applying each of the observation vectors to a respective one of the plurality of receiver modules $(20^1,\ldots,20^{NI},20^d)$;

each receiver module comprising;

channel identification means (28) for deriving from one of the observation vectors a channel vector estimate $(\underline{H}_n^1,\ldots,\underline{H}_n^{NI};\underline{Y}_{0,n}^d;\underline{Y}_{0,n-1}^I)$ based upon parameter estimates of the channel between the base station receiver and the corresponding user station transmitter;

beamformer means ($27^1,\ldots,27^{NI},27^d; 47^d$) having coefficient tuning means (50) for producing a set of weighting coefficients in dependence upon the channel vector estimate, and combining means (51,52) for using the weighting coefficients to weight respective ones of the elements of a respective one of the observation vectors and combining the weighted elements to provide a signal component estimate $(\hat{s}_n^1,\ldots,\hat{s}_n^U)$; and symbol estimating means ($29^1,\ldots,29^U, 30^1,\ldots,30^U$) for deriving from the signal component estimate an estimate $(\hat{b}_n^1,\ldots,\hat{b}_n^U)$ of a symbol $(b_n^1,\ldots,b_n^U)$ transmitted by a corresponding one of the user stations ($10^1,\ldots,10^U$),

wherein said receiver further comprises means (42,43) responsive to symbol estimates $(\hat{b}_n^1,\ldots,\hat{b}_n^{NI}; g^1, g^2, g^3; g^{I,\ldots})$ and to channel estimates $(\mathcal{H}_n^1 \ldots \mathcal{H}_n^{NI}; \mathcal{H}_{n-1}^I)$ comprising at least said channel vector estimates $(\hat{H}_n^1,\ldots,\hat{H}_n^{NI})$ for channels ($14^1,\ldots,14^{NI}$) of a first group (I) of said plurality of user stations ($10^1,\ldots,10^{NI}$) to provide at least one constraint matrix $(\hat{C}_n)$ representing interference subspace of components of the received signal corresponding to said predetermined group, and in each of one or more receiver modules ($20A^d$) of a second group (D) of said plurality of receiver modules, the coefficient tuning means ($50A^d$) produces said set of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_n)$ and the channel vector estimates $(\hat{H}_n^d)$ so as to tune said one or more receiver modules ($20A^d$) each towards a substantially null response to that portion of the received signal (X(t)) corresponding to said interference subspace.

68 ~~56~~. A CDMA system according to claim ~~55~~ 67, the transmitter further comprising:

delay means for delaying the signals from the mapping means each by a branch-specific delay, forming a corresponding signalling pulse modulating the signalling pulse with a carrier frequency signal, and supplying the modulated signal to the antenna elements for transmission thereby.

69 ~~57~~. A CDMA system according to claim ~~55~~ 67, wherein, in the transmitter, the distribution unit means is arranged to group data signals dedicated for user stations into

a predetermined number N_G of groups and, when the number of users is less than or equal to the processing gain, assign all user signals to the same group, otherwise assigning user signals pseudo-randomly so as to tend to balance the number of users in each group.

70 ~~58~~. A CDMA system according to claim 67 ~~55~~, wherein the transmitter further comprises, for each group, space-time coding means comprising:

a channel coding unit for spreading user signals by a group specific set of orthogonal codes;

a scrambling unit for spreading each group of user signals with the same base station specific scrambling code; and

a spatial coding unit for mapping the total group signals $(G_1(t),\cdots,G_{N_0}(t))$ onto the antenna branch signals $(A_1(t),\cdots,A_{N_0}(t))$ by a linear transformation (M).

71 ~~59~~. A CDMA system according to claim 70 ~~58~~, wherein, in the transmitter, the channel coding unit assigns to each user in the group indexed g a chip-code chosen from a fixed set of $L_g \leq L$ orthogonal group specific L-chip codes $(a_{i,1}(t),\cdots,a_{i,L_g}(t))$. , the code-sets across groups being chosen subject to minimize the maximum cross-correlation, any code belonging to any group being orthogonal to any other code within the group while its cross-correlation with any out-group channelization code is minimized.

41 ~~60~~. A receiver according to claim 1, for use with a transmitter transmitting pilot-symbol assisted user signals comprising pilot symbols multiplexed with data symbols, the receiver further comprising demultiplexing means ($35V^d$) for demultiplexing the signal component estimates from the ISR beamformer to extract pilot signal component estimates and data signal component estimates and supplying the data signal component estimates to the decision rule unit ($29V^d$) and the pilot signal component estimates to an ambiguity estimation means ($31V^d$), the ambiguity estimation means ($31V^d$) smoothing or averaging each pilot signal component estimate $(\hat{s}_n^{\pi d})$ to provide an ambiguity estimate $(\hat{a}_n^d)$; conjugation means ($32V^d$) for deriving from the ambiguity estimate $(\hat{a}_n^d)$ its conjugate $((\hat{a}_n^d)^*)$ and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate $(\hat{b}_n^d)$ from the decision rule means ($29V^d$) to form an improved symbol estimate $(\hat{b}_n^d)$.

~~61.~~ 43 A receiver according to claim 1, further comprising a second ISR beamformer ($47V/2^d$) connected in parallel with the first ISR beamformer ($47V/1^d$) and responsive to the same channel coefficients and constraint matrix as the first ISR beamformer to derive from the observation vector ($\underline{Y}_n$) a pilot signal component estimate, ambiguity estimation means ($31V^d$) for smoothing or averaging the pilot signal component estimate ($\hat{s}_n^{\pi,d}$) to provide an ambiguity estimate ($\hat{a}_n^d$) , conjugation means ($32V^d$) for deriving from the ambiguity estimate ($\hat{a}_n^d$) its conjugate ($(\hat{a}_n^d)^*$) and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate ($\hat{b}_n^d$) from the decision rule unit ($29V^d$) to form an improved symbol estimate ($\tilde{b}_n^d$) .

~~62.~~ 42 A receiver according to claim ~~60~~ 41, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates ($\hat{a}_n^d$) .

~~63.~~ 44 A receiver according to claim ~~61~~ 43, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates ($\hat{a}_n^d$) .

~~64.~~ 56 A receiver according to claim ~~39~~ 46, for use with a transmitter transmitting pilot-symbol assisted user signals comprising pilot symbols multiplexed with data symbols, the receiver further comprising demultiplexing means ($35V^d$) for demultiplexing the signal component estimates from the ISR beamformer to extract pilot signal component estimates and data signal component estimates and supplying the data signal component estimates to the decision rule unit ($29V^d$) and the pilot signal component estimates to an ambiguity estimation means ($31V^d$), the ambiguity estimation means ($31V^d$) smoothing or averaging each pilot signal component estimate ($\hat{s}_n^{\pi,d}$) to provide an ambiguity estimate ($\hat{a}_n^d$) , conjugation means ($32V^d$) for deriving from the ambiguity estimate ($\hat{a}_n^d$) its conjugate ($(\hat{a}_n^d)^*$) and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate ($\hat{b}_n^d$) from the decision rule means ($29V^d$) to form an improved symbol estimate ($\tilde{b}_n^d$) .

57 ~~65~~. A receiver according to claim 46 ~~39~~, further comprising a second ISR beamformer ($47V/2^d$) connected in parallel with the first ISR beamformer ($47V/1^d$) and responsive to the same channel coefficients and constraint matrix as the first ISR beamformer to derive from the observation vector ($\underline{Y}_n$) a pilot signal component estimate , ambiguity estimation means ($31V^d$) for smoothing or averaging the pilot signal component estimate ($\hat{s}_n^{\pi,d}$) to provide an ambiguity estimate ($\hat{a}_n^d$) , conjugation means ($32V^d$) for deriving from the ambiguity estimate ($\hat{a}_n^d$) its conjugate ($(\hat{a}_n^d)^*$) and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate ($\hat{b}_n^d$) from the decision rule unit ($29V^d$) to form an improved symbol estimate ($\hat{\underline{b}}_n^d$) .

56 ~~66~~. A receiver according to claim 55 ~~64~~, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates ($\hat{a}_n^d$) .

58 ~~67~~. A receiver according to claim 57 ~~65~~, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates ($\hat{a}_n^d$) .

39 ~~68~~. A receiver according to claim 19, further comprising buffering means (90^i), deinterleaving means (91^i), channel decoding means (92^i), re-encoding means (93^i) and re-interleaving means (94^i) for buffering a first frame of signal component estimates ($\hat{s}_{n-1}^i(1)$) , deinterleaving, channel decoding, re-encoding and re-interleaving the frame of signal component estimates to provide a frame of improved decided symbol estimates ($\hat{b}_n^i$) , and supplying same to the constraint set generator (42W), the constraint matrix generator (43W) forming therefrom an improved constraint matrix, the ISR beamformer ($47W^i$) using said improved constraint matrix to provide an improved signal component estimate ($\hat{s}_{n-1}^i(2)$) for use in a next iteration, the receiver repeating the iterations a predetermined number of times.

59 ~~69~~. A receiver according to claim 46 ~~39~~, further comprising buffering means (90^i), deinterleaving means (91^i), channel decoding means (92^i), re-encoding means (93^i) and

re-interleaving means (94^i) for buffering a first frame of signal component estimates $(\hat{s}^{i}_{n-1}(1))$, deinterleaving, channel decoding, re-encoding and re-interleaving the frame of signal component estimates to provide a frame of improved decided symbol estimates $(\hat{b}^{i}_{n})$, and supplying same to the constraint set generator (42W), the constraint matrix generator (43W) forming therefrom an improved constraint matrix, the ISR beamformer ($47W^i$) using said improved constraint matrix to provide an improved signal component estimate $(\hat{s}^{i}_{n-1}(2))$ for use in a next iteration, the receiver repeating the iterations a predetermined number of times.

45 ~~70~~. A receiver according to claim 1, wherein coefficient tuning means ($50A^d$) produces said set of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_n)$ and the channel vector estimates $(\underline{\hat{H}}^{d}_{n})$ so as to tune said one or more receiver modules ($20A^d$) each towards a response that is bound in magnitude to be close but not equal to a null.

60 ~~71~~. A receiver according to claim ~~39~~ 46, wherein coefficient tuning means ($50A^d$) produces said set of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_n)$ and the channel vector estimates $(\underline{\hat{H}}^{d}_{n})$ so as to tune said one or more receiver modules ($20A^d$) each towards a response that is bound in magnitude to be close but not equal to a null.